Dynamic Graphical Display in W3-EMRS
(An Implementation of Patient Summary Graphs in Java)

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The author has implemented a new graphical display, patient summary graphs as described by Powsner and Tufte(1), as a Java applet that will be used in the client-server environment of W3-EMRS(2).

Patient summary graphs are an alternative to the purely linear graphs, and flowsheets used in medicine today. The summary graphs, which can easily be extended for use in fields besides medicine, symbolically display uniform time and value axes for all medical parameters allowing doctors to focus on the trend of medical data. Though all medical data have different value ranges, most data do have normal, elevated and reduced ranges. Summary graphs display these ranges in a uniform manner for all data by creating non-linear junctions of linear segments. Doctors who use this type of display will not have to spend time interpreting arbitrarily chosen time or value ranges.

Figure 1 shows a summary graph of a fictitious patient's blood count level. The summary graph has three separate rectangular regions which display temporal data for a chosen parameter. The right region of the graph displays the most current data, the middle region displays the recent data on a compressed timeline, and the leftmost region displays all the previous data on a more compressed timeline. For the particular graph in Figure 1, the current period represents the time, in days, since the patient had been admitted to the hospital on 2.1.96, the middle region represents the time period of one year before admission, and the leftmost region represents all remaining time.

Consistent among all graphs is the value axis, which runs vertically, and contains five different regions for displaying data. Using ranges supplied by the user as arguments to the applet, the bottom region represents critically reduced data, the region above it represents reduced data, the middle region represents normal data, the region above it represents elevated data, and the region above that represents critically elevated data.

The Java implementation of these summary graphs embeds medical data in HTML as a parameter to the Java applet. After the client browser downloads the applet code, and the corresponding HTML which calls it, no more connections need to be made back to the server. All graphical calculations are done using the client's processor.

By eliminating all the network and processing overhead associated with server-side processing, the patient summary applet creates a responsive user interface. The author has tried to take advantage of this benefit by adding controls in the applet that allow the user to choose the display format of the summary graphs.

One control allows the user to change the current period to represent a segment of time that spans 24 hours for Intensive Care Unit (ICU) data, several days for non-intensive inpatient data, or a year for outpatient data. The corresponding middle and left-most regions will change accordingly when the user changes the current region.

Another control reduces the number of data points displayed in the graph by drawing a vertical line representing the range of data values displayed on each pixel column, and then displaying the median value for that range. For very high-intensity data, which clutters the three regions and makes data interpretation next to impossible, this option allows the user to see the trend that the median value is taking.
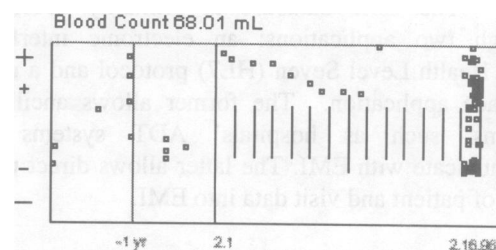

Figure 1: A patient summary graph.

REFERENCES
1. Powsner SM, Tufte ER. Graphical Summary of patient status. Lancet , August 1994: 344(8919):386-389.
2. Kohane IS, Greenspun P, Fackler J, Cimino C, Szolovits P. Building national Electronic Medical Record Systems via the World Wide Web. JAMIA, 1996:3(3). In press.